Wildfire Detection
Code 586/ Jerry Miller

A Code R, Computing, Information and Communications Technology (CICT) Program funded project

The Information Systems Division

Goals, Objectives, Benefits

- GOAL: Promote automation of NOAA NESDIS's (National Environmental Satellite, Data, and Information Service) fire detection procedures.
- OBJECTIVE: Mimic Fire Analysyts' fire/nonfire decision making process as well as sensor–specific fire detection algorithms.
- BENEFIT: Allows NOAA to transition from a national to global fire product as urged by climate modelers.

Approach

- Accumulate GOES, AVHRR, MODIS sensor data for ~ 1 year.
- Extract neural network training sets from each set of imagery.
- Train 3 separate neural networks to recognize fire patterns using NOAA fire product as reference.

Approach (continued)

- Spectral Bands provided by NOAA:

  GOES: 0.62, 3.9, 10.7 μm

  AVHRR: 0.63, 0.91, 3.7 μm

  MODIS: 0.66, 0.86, 3.96 μm
- Investigate 3 different ways to characterize fires across 3 spectral channels:
  - instantaneous single pixel
  - single pixel time series
  - pixel array

Approach (continued)

- Typical MODIS Spatial Fire Signature
  (intensity or brightness temperature scaled to 0 - 255)

CH1 (0.66 µm)

70	65	65	73	74	71	66
81	76	80	68	67	61	63
74	75	74	75	75	61	62
63	71	80	81	79	66	63
62	69	77	78	77	69	59
69	75	69	78	77	67	72
85	82	65	69	67	72	79

CH2 (0.86 µm)

139	156	155	125	133	135	145
151	143	141	129	129	137	142
146	143	143	136	129	145	142
144	146	128	127	128	138	142
148	144	138	124	125	134	145
140	145	147	123	123	138	131
129	136	148	141	144	146	136

CH22 (3.96 µm)

46	51	48	35	35	38	48
41	38	35	41	43	51	50
46	41	34	20	42	53	52
52	21	3	0	21	51	51
51	36	4	28	43	49	56
41	42	50	48	41	49	42
28	35	47	47	49	43	37

Approach (continued)

147-10-1 MODIS, GOES or AVHRR FFBP NEURAL NETWORK

Band A

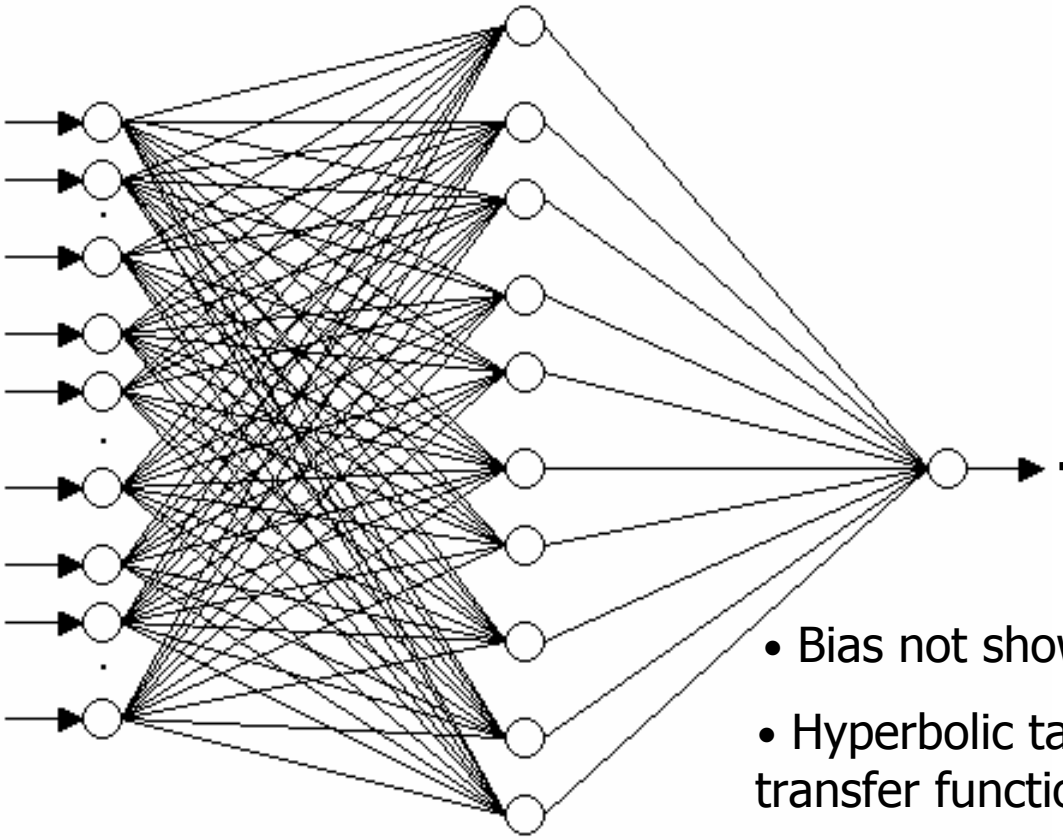
Inputs: 1 - 49

Band B

Inputs: 50 - 98

Band C

Inputs: 99 - 147



Fire

NonFire

- Bias not shown
- Hyperbolic tangent transfer functions

Results

ERROR MATRICES

SENSOR: MODIS

Classified Data	Reference: Fire	Reference: NonFire	
Fire	2834 (TP)	173 (FP)	3007
NonFire	318 (FN)	3103 (TN)	3421
	3152	3276	6428

	PRODUCER'S ACCURACY	USER'S ACCURACY	OVERALL ACCURACY
FIRE:	TP/(TP+FN) 89.9%	TP/(TP+FP) 94.2%	(TP+TN)/SAMPLES 92.3%
NONFIRE:	TN/(FP+TN) 94.7%	TN/(TN+FN) 90.7%	

SENSOR: AVHRR

Classified Data	Reference: Fire	Reference: NonFire	
Fire	5500 (TP)	479 (FP)	5979
NonFire	624 (FN)	4336 (TN)	4960
	6124	4815	10939

	PRODUCER'S ACCURACY	USER'S ACCURACY	OVERALL ACCURACY
FIRE:	TP/(TP+FN) 89.8%	TP/(TP+FP) 91.9%	(TP+TN)/SAMPLES 89.9%
NONFIRE:	TN/(FP+TN) 90.0%	TN/(TN+FN) 87.4%	

Results (continued)

ERROR MATRICES

SENSOR: GOES WEST

Classified Data	Reference: Fire	Reference: NonFire	
Fire	4826 (TP)	771 (FP)	5597
NonFire	1451 (FN)	6432 (TN)	7883
	6277	7203	13480

	PRODUCER'S ACCURACY	USER'S ACCURACY	OVERALL ACCURACY
FIRE:	TP/(TP+FN) 76.8%	TP/(TP+FP) 86.2%	(TP+TN)/SAMPLES 83.5%
NONFIRE:	TN/(FP+TN) 89.2%	TN/(TN+FN) 81.5%	

SENSOR: GOES EAST

Classified Data	Reference: Fire	Reference: NonFire	
Fire	7445 (TP)	2304 (FP)	9749
NonFire	1312 (FN)	7191 (TN)	8503
	8757	9495	18252

	PRODUCER'S ACCURACY	USER'S ACCURACY	OVERALL ACCURACY
	TP/(TP+FN) 85.01%	TP/(TP+FP) 76.3%	(TP+TN)/SAMPLES 80.1%
	TN/(FP+TN) 75.7%	TN/(TN+FN) 84.5%	

Status

- Last SW module which scans imagery for possible fires and supplies 3-ch vectors for neural processing undergoing debugging.

Next Steps

- Awaiting Code T, Software, Intelligent Systems & Modeling (SISM) funding for 3rd year of Wildfire Detection Project.

- Wildfire prediction (spin-off) may be funded by a Code Y CAN.